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## Participatory investment in some infrastructure projects and its impact on GDP in selected countries

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### Abstract

The research seeks to give a summary of the public-private partnership in infrastructure and the impact of this partnership on GDP, by reviewing the justifications and motives that call for resorting to partnership between the public and private sectors. as this research dealt with the concept of the transport sector and the water and sanitation sector as independent variables that represent participatory investment and their impact on the GDP dependent variable using the self-regression model with distributed slowdown Panel ARDL. Among the most significant essential outcomes that emerged in the long term is the existence of a positive impact, which means that the positive relationship between the independent variable of the transport sector and the GDP dependent variable, as well as the positive relationship between the water and sanitation sector and GDP in the short term. In the long term, the relationship is direct between the transport sector and GDP, and the study concluded that participatory investment is one of the important tools that contribute positively, qualitatively and significantly to the establishment, development, management and improvement of public infrastructure and utilities efficiency.

**Keywords:** Participatory investment, infrastructure, some macroeconomic variables

### Introduction

One of the most significant things that nations do is participate in investment, since governments usually handle the process of creating and supplying the infrastructure that is required for the establishment of various economic activities in the country. The issue of partnership in investment between the public and private sectors has drawn a lot of attention from governments, communities, and research institutions worldwide since it became evident that bringing together all of society's resources, energies, and expertise from the public and private sectors is essential to the process of economic and social development. In order to build and run projects of all kinds, resources and skills from the public and private sectors must be shared through cooperative institutional bodies. To create mutual benefit for all stakeholders participating in the participatory investment process, both developed and developing countries aim to establish institutions, laws, and processes based on participatory organizations.....

Since many of these services require large initial investments and take a while to pay for themselves, as well as the desire for better and more efficient services and the need for additional funding, governments are increasingly. Being pressured to adopt joint ventures between the public and private sectors in order to provide these services, public-private partnerships have primarily been used in the areas of basic economic infrastructure, such as roads, energy, wireless communications, and water. However, more attention has recently been paid to other infrastructure, such as social infrastructure, including health and education services.

### Research problem

The problem of research is the impact on the inability of the government sector to face the achievement of high rates of growth individually and the extent of the role that meet some macroeconomic variables to attract and create participatory investments.

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### The Significance of the Research

The importance of the research stems from the role played by participatory investments in some infrastructure projects in activating some macroeconomic variables and improving the economic performance of the country, as this is an important topic for countries that suffer from weakness in some of their economic sectors, especially the public sector in providing the required services.

### Research Hypothesis

The research assumes that there are significant relationships between participatory investment and some macroeconomic variables.

### Research objective

1. The research aims to clarify the impact of participatory investment on some macroeconomic variables.
2. Clarify the concept of public-private partnership, its importance and its financing and development role.
3. Highlighting the different experiences of some countries in the management of infrastructure services according to the company's mechanism between the public and private sectors.

### Methodology

The research relied on the descriptive approach to the variables of public-private partnership as well as the GDP variable. The quantitative approach was also used to analyze the relationship between the variables studied.

### Search Limitations

The scope of the spatial research included a group of selected countries (Brazil, China, Mexico), while the time period was (1992-2022) based on the data provided by the World Bank for the research sample.

### The first topic

#### Conceptual Framework for Infrastructure and Participatory Investment

##### The first requirement: Infrastructure

##### First: The Concept of Infrastructure

There are several concepts of infrastructure projects, depending on their economic or social nature or both, as well as the difference in their purpose or the goal they contribute to achieve. They can be defined as "the sum of the services provided by the state and the facilities that operate and build them, In addition to labor-intensive services like public transport, roadways, airports, ports, railways, power plants and their networks, drinking water facilities, natural gas, sewage systems, telecommunications, housing, education, and healthcare, infrastructure investments often demand substantial funds and extensive budgets. The nature of these investments typically results in significant value addition for the state. Consequently, the state generally oversees these programs, including expenditure, operation, and maintenance, rather than delegating these responsibilities to the private sector (Ben Zaway, 2018: 65) <sup>[2]</sup>. The Industrial Development Authority defines it as "an interconnected set of elements and facilities that provide structural support for economic and social development, and it expresses a broad concept that refers to roads, airports and other benefits and represents the physical basic systems of the state or population community, including green infrastructure, information and

communication technology, logistics infrastructure and others".

### Infrastructural Components

Infrastructure comprises a comprehensive list of essential elements necessary to support human and commercial activities. Some of these components are detailed below (Azza *et al.*, 2018: 237) <sup>[12]</sup>:

1. **Telecommunications:** In today's world, telecommunications services are indispensable. The development of telecommunications has transformed the world into what some describe as a "global village," thanks to the proliferation of communication channels such as mobile phones, the Internet, laptops, and satellites. These advancements enable seamless communication anywhere and anytime. Therefore, to prevent society from becoming isolated from the outside world and to ensure access to vital information, the state must provide these services to all citizens.
2. **Sanitation:** Sanitation services are fundamental in urban areas. If these services are absent or function inefficiently, they can cause environmental problems, leading to the spread of diseases and pollution. This can result in numerous issues both within and outside cities.
3. **Roads:** Over the past 20 years, the industry that deals with networks like roads and bridges has experienced significant growth and is currently attempting to make changes where they can. The relationship between users of bridges and roadways and the technology framework have been connected to this shift. It is not necessary for every tourist destination to have highways in order to draw automobile tourism; rather, it is sufficient for the roads to have enough width to accommodate the present and anticipated flow of cars in a comfortable and safe manner.
4. **Electricity:** Electricity is one of the most important pillars of economic and social infrastructure around the world. Today, the development of a nation can be measured by the per capita consumption of electrical energy, as this is reflected in the social and economic situation of society, where all forms of modern industry and agriculture cannot do without it (Jaafar and Rizziqa, 2012: 8) <sup>[8]</sup>.
5. **Health care:** Health care has recently witnessed extensive attention at all levels, as the topic of "Quality of health service has become one of the most important components of the infrastructure and a focus of attention in the quest of hospital institutions to provide their health services with high quality to achieve maximum satisfaction for the patient and also for the workers who provide health service. The health system that is related to the health and construction of a complete human being is considered health in terms of physical, mental and social health in addition to its reflection on the national economy, and because of the comprehensive impact of its service on all members of society (Ibrahim *et al.*, 22:2019) <sup>[17]</sup>.

### The second requirement: Participatory investment

#### First: The concept of participatory investment

Participatory investment is a type of investment that takes place between the public and private sectors. It is one of the main means that can participate in financing major projects and public utilities in the field of infrastructure.

Participatory investment between the public and private sectors is a form of cooperation and multiple interaction between the public and private sectors, with regard to the use of their organizational, technological, human, financial, knowledge & administrative skills based on involvement, dedication to objectives, and the freedom to choose shared responsibility in order to accomplish economic and social goals that affect a greater number of society members and have a lasting effect on their aspirations so that society can effectively keep up with modern developments and improve its competitive position. (Karamin, 2019: 254) [14].

Each international body has addressed the issue of public-private partnership in line with its principles, and has set a specific definition for it, and among the total of these definitions we mention (Wassila and Abbas, 2018: 206) [16]:

1. The definition of the International Monetary Fund: "Public-private partnership represents the arrangements that allow the private sector to provide infrastructure assets and services that were traditionally provided through the government. The partnership enters several areas of economic and social infrastructure, and is often concentrated in the construction and operation of hospitals, schools, prisons, roads, tunnels, road lighting networks, airports, ports, and water and electricity stations."
2. ADB definition: "PPP refers to the long-term contractual relationship between these two sectors in the financing, design, implementation and operation of infrastructure projects and services, which have traditionally been provided by the public sector."

### Second: Participatory Investment Objectives

The objectives are precisely defined in all areas, as the governments contracting with the private sector in partnership with it seek to implement a set of objectives and benefits of the partnership that can be identified below (Aljamal, 2016 : 1710) [9]:

1. Cutting back on spending by the government by shifting large-scale capital and investment projects to the private sector, which is more efficient, has the administrative capacity to adjust quickly to market conditions, and can quickly adapt to indicators of the market., especially in the field of education and health, and then providing the necessary funding for some sectors that the state cannot leave or withdraw from, such as (defense, security, judiciary).
2. Take advantage of the capital available to the private sector and its experience and knowledge in the management of projects in which the element of time is critical and reduce the time required to put them into practice and therefore elevate the status of public administration.
3. Promote principles of transparency and accountability in how resources are managed.
4. The collaboration creates new economic opportunities for medium-sized and small businesses in marketplaces from which they were previously shut out or unstable..
5. shifting risks—like design, construction, maintenance, and financing—that are better suited for the private sector's management (away from the limited resources of the government). Additionally, it seeks to improve the state of the economy, reallocate roles between the public and private sectors, achieve high growth rates by bolstering the private sector's position in the national

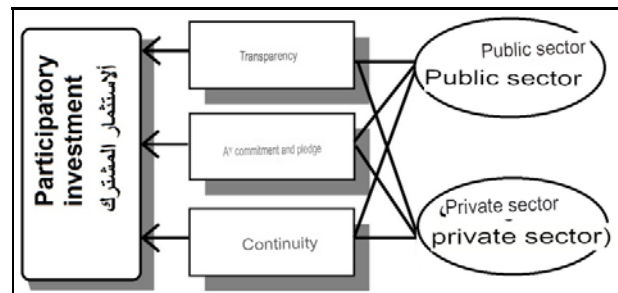
economy, and enhance public services by drawing in private sector investments. (Bushmal, 2021: 14) [4].

### Third: Justifications for Participatory Investment

Among the most important justifications for resorting to the partnership method (Issa, 2018: 43) [13]:

1. Limited financial, human and technological resources in the public sector due to the multiplicity of areas and projects to be implemented.
2. The inability of governments to achieve sustainable development on their own through their limited capabilities.
3. Accelerating technical and economic change and opening the opportunity to reduce the cost of projects.
4. The partnership mitigates competition between these areas by exchanging commitments between partners.
5. Increased competition pressures and lower growth rates.
6. Use logical division of labor and comparative advantage to increase effectiveness and efficiency.

### Fourth: The general principles that must be met in participatory investment



Source: Prepared by the researcher with reliance on the source (Waiba, 2014: 216)

### The third requirement: Some macroeconomic variables

Conceptual framework for some macroeconomic variables  
Some of the most important macroeconomic variables are mentioned

1. **GDP:** GDP is defined as the market value of all final goods and services produced by a community or local economy.
2. **Inflation:** There are many definitions of inflation, but in general, inflation is a large and continuous rise in the general level of prices accompanied by a decline in the real value of money (Parkin, 1977, 164) [18].
3. **Unemployment:** The definitions addressed by unemployment differed, but they agreed on the concept and the basic meaning of it as the case of the presence of people willing to work, able and looking for it, but did not find it, as defined by the International Labor Organization as "a term that includes all unemployed persons despite their readiness for it, and their search for it, and they have reached the legal age for work" (Al-Balawi and Al-Badrani, 2023: 58) [1].
4. **The exchange rate:** The value of one unit of the foreign currency estimated in units of the local currency, or vice versa, the value of one unit of the local currency estimated in units of the foreign currency, indicates that one of the two currencies is a commodity and the other is a price for it. In other words, the units of the foreign currency can be

exchanged for one unit of the national currency, and vice versa. (Al-Zawi, 2016 :14) <sup>[10]</sup>.

5. **Economic growth:** Economic growth is the occurrence of a real increase in real per capita income and not monetary. Economic growth does not occur without continuous increases in income. Subsidies are usually granted to a country that increases the average real income for a period of one or two years, but it is considered a temporary increase and not growth. Economic growth is a necessary but insufficient

condition for raising the standard of material life of individuals (Al-Abadi, 2018 :6) <sup>[11]</sup>.

## Second Section

Analysis of the reality of some macroeconomic variables and participatory investment of the selected countries

The first requirement: Analysis of the reality of the macroeconomic variables of the selected countries.

First: GDP Developments in Brazil

**Table 1:** GDP in Brazil during the period (1992-2022) (million dollars)

Year	Gross domestic product	Distribution of manufacturing value added among developing countries, 2000-2007
1992	390567	-----
1997	883207	4
2002	509795	-9
2007	1397114	2.6
2012	2465228	-6
2017	2063515	15
2022	1920096	16
Moderate	1347418	-----

**Source:** Researcher's work based on World Bank data published on the Bank's website

Through Table (1), we note that the timeline has witnessed varied changes during the relatively long study period, as we note that Brazil's GDP was increasing at an increasing pace during the period (1992-1995), after it was (390567 million US dollars) in 1992, and then continued to increase until it became (769333 million US dollars) in 1995, achieving the highest positive annual growth rate during the study period (41%).

As a result of the recession that occurred in the early 1990s, Brazil was able to achieve high surpluses in the field of international trade after pursuing policies related to the exchange rate and liberalization of imports, and through this it was able to pay interest on external debt and strengthen foreign reserves to peak in 1994.

In 2002, as a result of the financial crisis that hit Argentina and the United States, two of Brazil's trading partners, Brazilian GDP fell to (US \$559,984 million) and (US \$509,795 million) with negative annual growth rates of (-15%) and (-9%), respectively (HRI International Instruments, 2003, 7).

It is worth mentioning that Brazil's GDP recorded an increase in 2017, but it did not work in the midst of the Great Depression suffered by the economy, so that the Brazilian GDP became (2063515 million US dollars) with a positive annual growth rate of (15%). As for the significant deterioration in the value of the Brazilian GDP in 2020, it was caused by the repercussions of the spread of the Coronavirus (Annual Economic Report of the Central Bank of Brazil, 2020, 66-68) <sup>[6]</sup>.

In 2022, the Brazilian GDP recorded a remarkable and continuous increase to reach (1649623 million US dollars) and (192,096 million US dollars) with positive annual growth rates of (12%) and (16%) respectively, after achieving positive growth in the field of industry, and the growth of electricity, gas, water, sewage and waste management activities by (10.1%), which had more favorable real price indicators in 2022 (Annual Economic Report of the Central Bank of Brazil, 2022, 20-21) <sup>[6]</sup>.

## Second: GDP Developments in China

**Table 2:** GDP developments in China during the period (1992-2022) (USD million)

Year	Gross domestic product	GDP growth rate (%)
1992	426916	-----
1997	961602	11
2002	1470558	10
2007	3550328	29
2012	8532186	13
2017	12310491	10
2022	17963171	1
Moderate	6048673	-----

**Source:** Researcher's work based on (World Bank data) published on the Bank's website

Through Table (2), it is clear to us that it was increasing throughout the duration of the study, after it was (426,916 million US dollars) in 1992, and then it continued to increase until it became (17963,171 million US dollars) in 2022, and that the highest positive annual growth rate during the period of the study was (30%) in 1995, while the lowest annual growth rate was positive (1%) in 2022, as there was no negative annual growth rate. The reason for this continuous increase is due to the continuous growth in the

Chinese industrial sector, as world statistics for 2006 indicate that China's GDP reached (15.1%) of global GDP, and that its exports have recorded a continuous increase as the proportion of its exports to world exports has reached (7.2%) in the same year. It is noteworthy that the majority of its exports are in cheap and expensive industrial goods that invade the markets of all countries of the world, (Economic IMF outlook, 2007, 225).



**Third: GDP Developments in Mexico****Table 3:** GDP developments in Mexico during the period (1992-2022) (USD million)

Year	Gross domestic product	GDP growth rate (%)
1992	363158	-----
1997	500416	22
2002	772110	2
2007	1052697	8
2012	1201094	2
2017	1158912	7
2022	1414187	11
Moderate	908426	-----

Source: Researcher's work based on World Bank data published on the Bank's website

Through Table (3), we note the GDP of Mexico during the period (1992-2022), and it is clear to us that it was increasing during the period (1992-1994), as it was (363,158 million US dollars) in 1992, after which it continued to increase until it became (527,811 million US dollars), with a positive annual growth rate of (5%) in 1994, while in 1995, Mexico's GDP decreased to (360073 million US dollars) with a negative annual growth rate of (-34%), which, over the research period, has the lowest yearly growth rate, and the reason for this decrease was attributed to the so-called (Tequila) crisis, which greatly damaged Mexico's economy and banking system after the collapse of the Mexican local currency (Mexican annual economic report, 2003, 35).

During the period (2010-2014), the GDP in Mexico recorded a continuous increase, as it became (1057801

million US dollars) in 2010 with a positive annual growth rate of (18%), after which it continued to increase until it became (1315356 million US dollars) in 2014, with a positive annual growth rate of (3%). This continuous increase is due to the continuous increase in global oil prices and reaching high levels of more than (100 dollars per barrel). In 2015 and 2016, the GDP of Mexico decreased to become (1171870 million US dollars) and (1078493 million US dollars) with negative annual growth rates of (-11%) and (-8%) respectively, after the decline in world oil prices, but during the period (2017-2019) and after the recovery of world oil prices, GDP recovered to become (1158912 million US dollars) with a positive annual growth rate of (7%) in 2017, and then continued to increase until it became (1269010 million US dollars) with a positive annual growth rate of (4%) in 2019, but in 2022 and after the gradual disappearance of the threat of the Corona virus, output recovered. The Mexican GDP reached (1272839 million US dollars) and (1414187 million US dollars) with positive annual growth rates of (11%).

**The second requirement: Analysis of the reality of the participatory investment sectors of the selected countries**

This request includes an analysis of the reality of the selected participatory investment sectors (transport sector, water & sanitation sector) in the selected countries during the period (1992-2022) as follows:

**First: Investment developments in the transport sector and the water and sanitation sector in Brazil****Table 4:** Investment developments in the transport, water & sanitation sector in Brazil during the period (1992-2022) (million dollars)

Year	Investment in the public transport sector plan	Transport sector investment growth rate (%)	Year	Water and Sanitation Sector	Growth rate of investment in the water and sanitation sector (%)
1992	495	-----	1992	41	-----
1997	4048	-7	1997	473	716
2002	181	-81	2002	207	670
2007	3915.00	499	2007	141	-63
2012	22147	245	2012	4573	3487
2017	550	-39	2017	219	-2
2022	3308	-52	2022	2419	-57
Moderate	5471	-----	Moderate	842	-----

Source: Researcher's work based on World Bank data published on the Bank's website

We note that the value of investment in the transport sector in Brazil was very different, but it was low in most years of study and by less than (1 billion US dollars), except for three periods:

**First:** Which included the period (1995-2000), after the investment in the transport sector became (996 million US dollars) in 1995, with a positive annual growth rate of (204%), and then continued to increase until it became (1616 million US dollars) in 2000, with a positive annual growth rate of (2899%), which is the highest annual growth rate during the period of the study, noting its decline in 1999 to become (54 million US dollars), which is the lowest value during the period of the study, and with a negative annual growth rate that is the lowest during the period of the study and by (-99%), and the reason for this great and continuous increase is due to the government's interest in investing in infrastructure and the construction and paving of transport roads, as the investment reached (13,824 kilometers) of

roads during the period (1995-2000) (International Covenant, 2022, 125).

**The second:** Which included the period (2007-2014). Investment in the transport sector recorded a qualitative leap that decreased during the period of the study, as after the value of investment in the transport sector in Brazil became (3915 million US dollars) in 2007 with a positive annual growth rate of (499%), and then continued to increase despite some decreases in 2010 and 2013, until it became (33479 million US dollars) in 2014 with a positive annual growth rate (208%). The reason for this great and continuous increase is due to the growth acceleration plan adopted by the Brazilian government, which includes increasing government investment in building hundreds of highways, bridges and transport lines.

**Third:** Which included the period (2018-2022), after the investment in the transport sector in Brazil became (1041 million US dollars) in 2018 with a positive annual growth

rate of (89%), its value remained high until it became (3308 million US dollars) in 2022 with a negative annual growth rate of (-52%), as it was in 2021 with a higher value of (6878 million US dollars) and a high positive annual growth rate of (2338%), noting its significant decline in 2020 due to the repercussions of the spread of the coronavirus. This increase in the values of investment in the transport sector in Brazil is due to the participation program between (GI Hub) the Global Infrastructure Center and the Brazilian government to introduce more bankable projects and more private sector investment in infrastructure, bringing the government more than (44 billion US dollars) in infrastructure projects for public auction and seek the participation of the private sector in successful projects that meet the goals of sustainability and flexibility in Brazil. As for the developments in the investment values in the field of water and sanitation in Brazil, they were also very different, but they were low in most years of schooling and by less than (1 billion US dollars), except for two periods:

**First Period (2012-2015):** The investment in the water and sanitation sector saw a significant increase to \$4,572.8 million in 2012, with an impressive annual growth rate of 3,487%. Although it declined in subsequent years, it

remained above \$1 billion, reaching \$1,726.7 million in 2015 with a negative growth rate of -3%. This surge in investment was primarily driven by the development and reform plan for hosting the Confederations Cup in 2013, the World Cup in 2014, and the Olympic Games in 2016.

**Second Period (2020-2021):** During this period, investment in the water and sanitation sector rose to \$1,329.38 million in 2020 and \$5,614 million in 2021, with positive annual growth rates of 323% and 322%, respectively. Despite a subsequent decline, investment remained substantial, amounting to \$2,419 million in 2022, albeit with a negative growth rate of -57%. This significant leap in investment was attributed to Brazil's agreement with the European Investment Bank to fund large-scale projects related to climate and the environment.

#### Investment Developments in the Transport and Water and Sanitation Sectors in China (1992-2022)

Investments in these sectors during the period from 1992 to 2022 have shown notable trends and shifts, reflecting China's commitment to improving infrastructure in these critical areas.

**Table 5:** Investment Developments in the Transport and Water and Sanitation Sectors in China (1992-2022)

Year	Investment in the public transport sector plan	Transport sector investment growth rate (%)	Year	Water And Sanitation Sector	Growth rate of investment in the water and sanitation sector (%)
1992	533	-----	1992	61	-----
1997	3093	-39	1997	2.11	42
2002	1,787	178	2002	918	279
2007	4494	-46	2007	1902	215
2012	1879	72	2012	274	-54
2017	12587	263	2017	1426	50
2022	10603	63	2022	3098	-15
Moderate	4780	-----	Moderate	899	-----

**Source:** Researcher's work based on World Bank data published on the Bank's website

Table (5) shows the developments of investment in the transport sector in China for the period (1992-2022), and we note that its values varied significantly, especially in the last quarter of the study period, as it was at a high level during this quarter, and we note that its average for the entire period was (4.7 billion US dollars), and our focus in the analysis will be on the periods and years in which the level of investment in a sector was higher than its average for the entire period, namely:

**First:** The value of investment in the transport sector in 1996 became (5084 million US dollars), with a positive annual growth rate of (1544%), and the growth of the is the cause of this significant increase. railway project called (New Silk Road), which began work in 1992 and amounted to (4131 kilometers), as well as increased investment in highways (<https://www.mot.gov.cn/tongjishuju/tielu>). The second was the value of investment in the transport sector in China in 2005 and 2006, which amounted to (6629 million US dollars) and (8351 million US dollars), with a positive annual growth rate of (747%) and (26%), respectively.

This significant increase might be attributed to the growth of the aviation industry and the integration of the six major Chinese airlines to manage most of China's foreign flights through a large fleet of (860 aircraft) and (863 aircraft), respectively, as well as the establishment of many airports to

become (467 airports), and the expansion of the transport of goods through aviation.

**Third:** The value of investment in the transport sector in China in 2014 reached (5009 million US dollars), with a positive annual growth rate of (12%), and the reason for this great increase is due to the expansion of the construction of bridges, as their number reached more than (70 bridges).

**Fourth:** Which included the period (2017-2022), during which investment in the transport sector in China became very high, as it became (12,587 million US dollars) in 2017 with a positive annual growth rate of (263%), after which its value remained high until it became (10,603 million US dollars) in 2022 with a positive annual growth rate of (63%), noting that it decreased in 2020 by (2789 million US dollars) with a negative annual growth rate of (-88%), due to the repercussions of the spread of the Corona virus. This increase in the values of investment in the transport sector in China during this period is due to the launch of major railway transport projects in urban areas and subways and the expansion of port development significantly.

Table (5) also shows the developments of investment in the water and sanitation sector in China for the period (1992-2022), which varied greatly, but it was low in most of the years of study and less than (1 billion US dollars), and the population of China (about 1.5 billion people), and the

process of providing (20-30) liters of water per person is not easy, and the provision of sewage networks for the entire population needs for a period of time and large amounts. The World Bank indicates in its reports on investment in the water and sanitation sector in China that there are hundreds of millions of people still in need of sanitary water and regular sewage networks and sewage treatment plants. China has sought in the past two decades (2002-2024) to develop the reality of potable water and sewage networks, and we note through Table (10) and Figures (12) and (13) the developments of investment in the water and sanitation sector in China during the period (1992-2022), and we show that the value of investment in the water and sanitation sector during the period (1992-2001) was low (below the average) amounting to (899 million US dollars).

In 2002, it was (higher than the average) and by (918 million US dollars) with a positive annual growth rate of (279%), as well as during the period (2005-2008), investment values in the water and sanitation sector in China

recorded a continuous rise, as after its value became (1007 million US dollars) in 2005, and with a positive annual growth rate of (67%), it remained after that high until it became in 2008 by (974 million US dollars) with a negative annual growth rate of (-49%), noting that it was low in 2006 and by (604 million US dollars) with a negative annual growth rate of (-40%). During the period (2016-2022), the investment values in the water and sanitation sector in China increased continuously, after its value became (950 million US dollars) in 2016, with a positive annual growth rate of (23%), after which it remained high until it became (3097 million US dollars) in 2022 with a negative annual growth rate of (-15%). It is worth mentioning that it was at its highest value during the study period and by (3655 million US dollars) in 2021 with an annual growth rate Positive (58%).

### Third: Investment Developments in the Transport, Water and Sanitation Sector in Mexico

**Table 6:** Investment developments in the transport, water and sanitation sector in Mexico during the period (1992-2022) (million dollars)

Year	Investment in the public transport sector plan	Transport sector investment growth rate (%)	Year	Water And Sanitation Sector	Growth rate of investment in the water and sanitation sector (%)
1992	1922	-----	1992	23	-----
1997	3140	4137	1997	60	903
2002	71	-68	2002	113	57
2007	6146	124	2007	307	477
2012	1593	-42	2012	42	-84
2017	1007	138	2017	1114	2.8
2022	351	-46	2022	440	-5
Moderate	1155	-----	Moderate	351	-----

Source: Researcher's work based on World Bank data published on the Bank's website

Table (6) shows the developments of investment in the transport sector in Mexico for the period (1992-2022), and we note that its values varied significantly during the period of the study, as we note that its average for the entire period was (1.2 billion US dollars), and that our focus in the analysis will be on the periods and years in which the level of investment in the sector was higher than its average for the entire period, namely:

**First:** The value of investment in the transport sector in 1992 was (1922 million US dollars), and the reason for this great increase is due to the expansion of railway projects.

The second was the value of investment in the transport sector in 1997, as it became (3140 million US dollars), with a positive annual growth rate of (4137%), and the reason for this great increase is due to increased investment in roads and railway development.

**Third:** Which included the period (2005-2013), in which investment in the transport sector in Mexico became higher than its average for the entire period, as it became (1321 million US dollars) in 2005, with a positive annual growth rate of (172%), after which its value remained high until it became (3741 million US dollars) in 2013 with a positive annual growth rate of (135%), noting its decline in 2008 as it became (905 million US dollars) with a negative annual growth rate of (-85%). The reason for this increase in the values of investment in the transport sector in Mexico during this period is due to the large investment in the transport sector, especially multi-lane highways, as they reached (116802 kilometers) in 2006, as well as the

introduction of high-speed trains for service, in addition to the increasing investment in air transport until the number of airports reached (1806 airports) in 2009.

**Fourth:** The value of investment in the transport sector in 2017 reached (1007 million US dollars), with a positive annual growth rate of (138%). This significant increase is due to the increase in investment in passenger transport modes within Mexico.

Table (6) also shows the developments of investment in the water and sanitation sector in Mexico for the period (1992-2022), which varied greatly, but it was low in most years of study and less than its average for the entire period, which amounted to (351 million US dollars), and we note through Table (12) and Figures (18) and (19), that the value of investment in the water and sanitation sector in 1993 and 1994 has become (520 million US dollars), which is greater than the average for the entire period and with positive annual growth rates of (2180%) and (0%), respectively, Because it remained constant in 1994, as well as its value in 2004, which amounted to (422 million US dollars) with a positive annual growth rate of (353%). In 2010, its value increased to (793) with a positive annual growth rate of (175%), due to the expansion of water and sanitation projects in areas that are not available in it. During the period (2014-2022), the values of investment in the water and sanitation sector in Mexico increased significantly and continuously, after it became (1047 million US dollars) with a positive annual growth rate of (645%), its values remained higher. From its average for the entire period, it became (440 million US dollars) with a negative annual growth rate

of (-5%), as it decreased from what it was in 2021, as it was (464 million US dollars) with a positive annual growth rate, which is the highest during the study period and by (3058%). This significant increase in the annual growth rate is due to the fact that its value in 2020 was (15 million US dollars) with a negative annual growth rate of (-98%), due to the repercussions of the spread of the Corona virus.

**Section Three**

Measure and analyze the impact of participatory investment in some infrastructure projects on GDP in selected countries

**First: An explanation of the model.**

1. **Dependent variable (Y): GDP:** It is the market value of both final goods and services produced at the local level in a specific country and in a specific period, that is, all that is produced within the borders of the country (Radwan, 2022, 61).
2. **Independent variables (X):** The variables included:
  - a) **Participatory investment in the transport sector (X1):** The transport sector with its various activities and branches is an important component in the infrastructure of any national economy because of its significant positive impact on other economic sectors such as industry, trade, agriculture, tourism, etc. Transport has an effective role in economic development and is a dynamic role because it facilitates the movement of goods and people from one place to another beyond the space and time dimension. Investment in the transport sector includes all means of land transport, including toll roads, tunnels, bridges, railways, etc., as well as air and sea transport, which includes the construction of airports and ports. The transport sector includes all facilities and structures for transport management and control, and all public transport systems.
  - b) **Participatory financial support for the water and sanitation industry (X2):** The water and sanitation sector is one of the most important elements that play a

positive role in the development of the economies of countries, where the sewage network is defined as a set of processes that disburse the largest amount of unfit water, that is, the discharge of polluted water and rainwater into special channels and throwing them outside the urban perimeter after the treatment process. This sector includes investment in water purification, treatment centers, pumping, storage, water facilities, facilities, dams, water and sewage networks, and all that includes water collection, treatment and reuse. Water is an important goal of the production process, so the decrease in water supply leads to a slowdown in growth rates.

**Second:** Research sample static tests: The first steps of the quantitative side require testing and examining the stability of the data of the variables adopted in any scientific research, based on the (Levin, Lin & Chu t) test. At the (At Level), the dependent variable and the independent variables (X2, Y) are not static and have no unit root at the (Individual intercept), and at the (Individual intercept and trends), except for the independent variable (1X) it is static at the (Individual intercept), and at the (Individual intercept and trends), as well as in the (Im, Pesaran and Shin W-stat) test, the dependent and independent variables (X2, Y1, Y2) are not static and have no unit root at the (Individual intercept), and at the (Individual intercept and trends), except for the independent variable (X1) it is static at the (Individual intercept), and at the (Individual intercept and trends), in general, the previous results can be summarized that some variables are static at the level of the country, while others have a root of difference, which means that they show a degree of instability. As a result of this variation, the degree of stability can be classified as a combination of variables that have a unit root (1) and static variables (0) as shown in Table (1).

**Table 7:** Unit Root Test

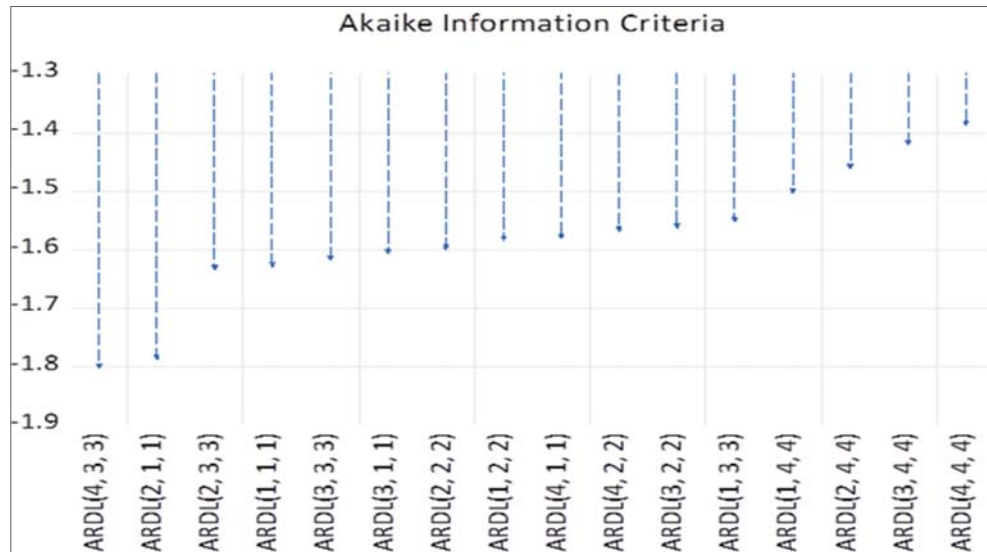
	Panel	Unit root test		Levin	Lin &	Chu t	IM	Pesaran and Shin	W-stat
		Individual	Intercept	Individual and	intercept trends	Individual	Intercept	Individual and	intercept trends
		t-Statistic	Prob.	t-Statistic	Prob.	t-Statistic	Prob.	t-Statistic	Prob.
	At Level	3.29824	0.999	-0.2088	0.4173	3.5575	0.999	0.8194	0.7937
Y	At First Difference	-2.5777	0.005	-2.1573	0.0155	-4.0075	0	-4.6303	0
	At Level	-3.4839	0.0002	-3.65782	0.0001	-2.263	0.0118	-1.8724	0.0306
X1	At First Difference	-6.9912	0	-5.79105	0	-6.91208	0	-5.8538	0
	At Level	0.58438	0.7205	-0.5044	0.307	0.43126	0.6669	-0.09789	0.461
X2	At First Difference	-4.44149	0	-3.56135	0	-5.1589	0	-4.27777	0

Based on this, the PMG/ARDL model can be applied to the standard model variables in the selected countries. This model is considered comprehensive as it includes the time dimensions of the long period and the short period, at the level of the countries in the study sample.

**Third: Appreciation**

1. **Determining the degree of slowdown:** To determine the appropriate degree of slowdown in the standard model, we automatically use according to the common statistical standard (Akaike) with four degrees to analyze the relationship between independent variables (X<sub>1</sub>, X<sub>2</sub>) and the dependent variable (Y<sub>1</sub>), and the following diagram shows this.





Source: Written by the investigator using the statistical software (12:EVIEWS)

Fig 1: The appropriate slowness scores for the first model

Through the diagram above, it is noted that the best degree of slowness is at (4) degrees for the dependent variable and (3) degrees for the independent variable.

**2. Cointegration test:** The Pedroni Residual Cointegration Test was used to determine whether the independent variables and the dependent variable have an integration connection, and the significance of the

results was determined based on the probability value (Prob), if the probability value is less than a significance level (5%) in three tests, and the fourth test is at a significance level (10%), thus we reject the null hypothesis (H:0) and accept the alternative hypothesis (H:1) that indicates a co-integration relationship between the studied variables, see Table (2).

Table 8: Joint integration testing of the first model

Pedroni Residual Cointegration Test					
Series: Y1X1X2					
Sample: 1992 2022					
Included observations: 93					
Cross-sections included: 3					
Null Hypothesis: No cointegration					
Trend assumption: No deterministic intercept or trend					
		Statistic	PROB	Statistic	PROB
Panelv-Statistic		-0.4550	0.675	-0.9343	8249
Panelrho-Statistic		-0.73295	2318	2.	0116
PanelPP-Statistic		0.98	1635	-2.14271	00-0161
Panel ADF-Statistic		0.045524	5182	-0.2233	4116
Alternative hypothesis: individual AR coifs. (Betwen-dimensional)					
		Statistic	PROB		
Grouprho-Statistic		-1.29098	0.0984		
GroupPP-Statistic		00874	0.0223		
GroupADF-Statistic		0.439059	0.6697		

Source: Written by the investigator using the statistical software (12:EVIEWS)

**3. Results of the long-term relationship: The results are shown in the following table (3):**

1. There is a positive impact, and this means that the relationship between participatory investment in the transport sector and GDP is positive, and that increasing investment in this sector by one unit leads to an increase in GDP by (0.061%) at a level of confidence (10%), and this is in line with the economic logic and what came in the study.
2. The results showed that there is a positive impact, and this means that the relationship between participatory investment in the water and sanitation sector and GDP is positive, and that increasing investment in this sector by one unit leads to an increase in GDP by (0.087%) at a level of confidence (5%), and this is in line with the

economic logic and what was stated in the study (Hamdouna-2017).

**4. Short-term relationship**

1. The results showed a positive impact, which means that the relationship between participatory investment in the transport sector and GDP is positive, but it is immaterial at a level of confidence (5%).
2. From the results, it was found that there is a negative impact, and this means that the inverse relationship between participatory investment in the water and sanitation sector and GDP, and that increasing investment in this by one unit results in a reduction of GDP by (0.025%) at a level of confidence (5%).

3. The coefficient of error correction or co-integration coefficient is shown with a negative and significant value at (5%) and its value is (-0.365), which means that (37%) of the deviations in the independent variables (transport sector, water and sanitation sector) in the dependent variable (GDP) are corrected in the following period in order to get back to the state of long-term equilibrium. This means that GDP takes approximately two years and eight months because  $\frac{1}{0.365} \cong 2.73$ , to return to its long-term equilibrium value after the effects of shocks and fluctuations in the independent variables, which is a good response.

**Table 9:** The relationship is long and short term

Independent variable:				
of Disbursement				
Date: 11/18/23 Time: 11:35				
Sample: 19962022				
Included observations:81				
Maximum dependent lags: 4 (Automatic selection)				
Model selection method: Akaike info criterion (AIC)				
Dynamic regressors (4 lags, automatic): log (X1) log (X2)				
Fixed regressors: C				
Number of models evaluated: 16				
Selected Model: ARDL(4, 3, 3)				
Note: final equation sample is larger than selection sample				
Variable	Coefficient	Std. Error	t-Statistic	PROB*
Long Run Equation				
(x1)	0.06140	0.03236	1.89706	0631
X2	0.08723	0.03821	2.28292	[0263]
Short Run Equation				
COINTEQ01	36576	0.110288	3:	0.0016
DLOG(Y1 (-1))	0.46447	0.14854	3.12676	0.0028
DLOG(Y1 (-2))	0.15984	0.14255	1.12128	2670
DLOG(Y1 (-3))	0.46422	0.040586	11.4380	0.0000
(x1)	0.00585	0.00418	1.40059	1670
DLOG(X1 (-1))	00291	0.029754	-0.09762	0.9226
DLOG(X1 (-2))	[00177]	0.009443	-0.18723	0.8522
(x2)	-0.02509	0.010173	2.	0.0168
DLOG(X2 (-1))	-0.0273	0.011092	-2.4692	555-016.
DLOG(X2 (-2))	-0.0135	0.003144	-4.3160	0.0001
C	4.46756	1.333263	3.35085	0.0015
MSE	0.059908	Mean dependent Var	0.067648	
S.D. dependent Var	0.123684	S.E. of Regression	0.077901	
Akaike info Criterion	-1.56679	Sum Squared Resid	0.333773	
Schwarz Criterion	53196	Log Likelihood	110.	
Hannan-Quinnriter.	-1.14895			

\*Note: p-values and any subsequent tests do not account for model

**Source:** Written by the investigator using the statistical software (12.EViews) as for the short term relationship at the. level. of one country.. it was as follows :

- Brazil:** The relationship between participatory investment in the transport sector and GDP is positive. Increasing investment in this sector by one unit leads to an increase in GDP by (0.010%). The relationship between participatory investment in the water and sanitation sector and GDP is inverse. Increasing investment in this section by one unit results in a reduction of GDP by (0.045%) at a level of confidence (5%) .
- China:** The relationship between participatory investment in the transport sector and GDP is positive. Increasing investment in this sector by one unit leads to an increase in GDP by (0.002%). The relationship

between participatory investment in the water and sanitation sector and GDP is inverse. Increasing investment in this sector by one unit results in a reduction of GDP by (0.014-%) at a level of confidence (5%).

- Mexico:** The inverse relationship between participatory investment in the transport sector and GDP, and that increasing investment in this sector by one unit leads to a decrease in GDP by (0.009%), and that the inverse relationship between participatory investment in the water and sanitation sector and GDP, and that increasing investment in this sector by one unit, leads to a decrease in GDP by (0.015-%) at a level of confidence (5%), see Table () .

**Table 10:** Short-term analysis results at the country level for the first variable

Brazil				
Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-0.51847	0.01308	-39.612	0
DLOG(Y1(-1))	0.74114	0.02966	24.9861	0
DLOG(Y1(-2))	0.43424	0.04353	9.97507	0.002
DLOG(Y1(-3))	0.54224	0.01763	30.7462	0
DLOG(X1)	0.01072	0.00049	21.8797	0
DLOG(X1(-1))	-0.05476	0.00045	-120.855	0
DLOG(X1(-2))	-0.02028	0.00037	-54.2721	0
DLOG(X2)	-0.04543	0.00031	-144.415	0
DLOG(X2(-1))	-0.04944	0.00023	-212.779	0
DLOG(X2(-2))	-0.01632	0.00012	-128.522	0
C	6.24082	1.80134	3.46454	0.04
@TREND	0.03062	4.21E+00	726.752	0
China				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ01	-0.15156	0.0043	-35.2056	0.0001
DLOG(Y1(-1))	0.41988	0.04033	10.4091	0.0019
DLOG(Y1(-2))	-0.04439	0.05851	-0.75864	0.5032
DLOG(Y1(-3))	0.44459	0.04788	9.28538	0.0026
DLOG(X1)	-0.00246	0.00012	-19.8196	0.0003
DLOG(X1(-1))	-0.00224	0.00012	-18.1277	0.0004
DLOG(X1(-2))	0.00426	0.00013	32.851	0.0001
DLOG(X2)	-0.01479	0.00046	-31.7456	0.0001
DLOG(X2(-1))	-0.01846	0.00031	-58.6922	0
DLOG(X2(-2))	-0.01709	0.00027	-62.6751	0
C	1.85628	0.61072	3.03947	0.0559
@TREND	0.01782	7.21E+00	247.269	0
Mexico				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ01	-0.42724	0.01561	-27.3602	0.0001
DLOG(Y1(-1))	0.23238	0.02661	8.733264	0.0032
DLOG(Y1(-2))	0.08968	0.02497	3.591243	0.0037
DLOG(Y1(-3))	0.40582	0.02197	18.47061	0.0003
DLOG(X1)	0.00932	0.0003	30.18692	0.0001
DLOG(X1(-1))	0.04829	0.00028	172.1352	0
DLOG(X1(-2))	0.01071	0.00016	65.47098	0
DLOG(X2)	-0.01504	0.00023	-64.3411	0
DLOG(X2(-1))	-0.01426	0.00014	-98.9322	0
DLOG(X2(-2))	-0.00729	0.0001	-69.069	0
C	5.30559	2.31367	2.293148	0.1057
@TREND	0.01206	2.52E+00	478.1386	0

**Source:** Written by the investigator using the statistical software (12.EViews)

**Conclusions**

- There is a positive impact over time., which means that the relationship between the independent variable of the

transport sector (1X) and the dependent variable of GDP (Y) is positive.

- Also, the relationship is positive between the water and sanitation sector (2X) and GDP (Y) in the long term.
- In the long term, the relationship is positive between the transport sector (1x) and GDP (Y).
- It was found that there is a negative impact, that is, an inverse relationship between the water and sanitation sector (2X) and GDP(Y)in the short term.

### Recommendations

1. Before implementing any partnership program between the two sectors so that alternatives and options are ready and clear to decision-makers, conducting extensive studies and research on the economic infrastructure sectors due to the different nature and factors affecting these sectors in order to identify and determine the form of the participatory investment relationship between the public and private sectors in these sectors in order to ensure the continuity of the services provided in the future.
2. Stressing the significance of the state's role in maintaining and supervising the establishment of an oversight system consisting of a number of government agencies and popular committees to ensure compliance with the agreements reached between the public and private sectors for the access of appropriate prices and services to citizens, and emphasizing that the state does not interfere in its domination and tyranny in a way that hinders or hinders the production process.

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